

CHAPTER 11

Hypovolemia

KEY TEACHING POINTS

- In elderly patients with acute illness, four physical findings accurately detect hypovolemia: sunken eyes, abnormal skin turgor (subclavicular space), dry oral mucosa, and dry axilla.
- The absence of tongue furrows and presence of normal skin turgor decrease the probability of hypovolemia.

I. INTRODUCTION

The term *hypovolemia* refers collectively to two distinct disorders: (1) **volume depletion**, which describes the loss of sodium from the extracellular space (i.e., intravascular and interstitial fluid) that occurs during gastrointestinal hemorrhage, vomiting, diarrhea, and diuresis; and (2) **dehydration**, which refers to the loss of intracellular water (and total body water) that ultimately causes cellular desiccation and elevates the plasma sodium concentration and osmolality.¹ Chapter 17 discusses the accuracy of abnormal vital signs in patients with volume depletion; this chapter discusses assorted additional findings.

II. THE FINDINGS AND THEIR PATHOGENESIS

Many of the traditional signs of hypovolemia—dry mucous membranes, sunken eyes, shriveled skin, poor skin turgor, and confusion—were originally described historically in patients with cholera who were near vascular collapse.² Presumably, cellular dehydration, interstitial space dehydration, and poor perfusion contribute to these signs.

Poor skin turgor refers to the slow return of skin to its normal position after being pinched between the examiner's thumb and forefinger.^{3,4} In one study, the persistence of skin tenting for 3 or more seconds after 3 seconds of pinching was defined as abnormal.⁵ The protein elastin is responsible for the recoil of skin, and in vitro experiments show that its recoil time increases forty-fold after loss of as little as 3.4% of its wet weight.³ Elastin also deteriorates with age, however, suggesting that the specificity of poor skin turgor diminishes as patients age.

III. CLINICAL SIGNIFICANCE

EBM Box 11.1 presents clinical studies comparing traditional signs to laboratory tests of hypovolemia (i.e., elevated serum urea-to-creatinine level, serum osmolality, or serum sodium). These studies enlisted mostly elderly patients presenting to emergency departments with vomiting, decreased oral intake, or diarrhea. Few if any were as desperately hypovolemic as patients with classic cholera.



EBM BOX 11.1
*Hypovolemia**

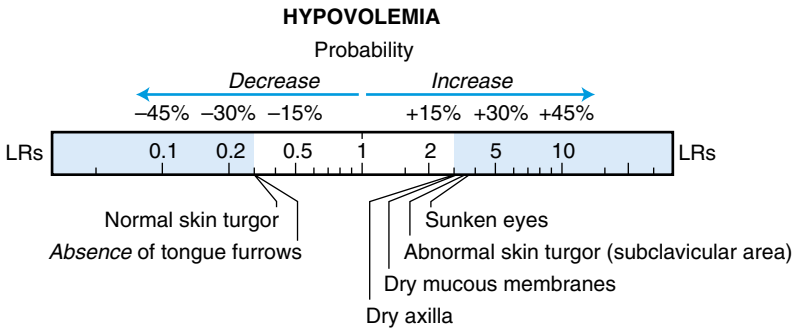
Finding (Reference) [†]	Sensitivity (%)	Specificity (%)	Likelihood Ratio [‡] if Finding Is	
			Present	Absent
Skin, Eyes, and Mucous Membranes				
Dry axilla ^{6,7}	40-50	82-93	3.0	0.6
Dry mucous membranes of mouth and nose ^{5,8}	49-85	58-88	3.1	0.4
Longitudinal furrows on tongue ⁸	85	58	NS	0.3
Sunken eyes ^{7,8}	33-62	82-93	3.7	0.6
Abnormal skin turgor (subclavicular area) ⁵	73	79	3.5	0.3
Neurologic Findings				
Confusion ^{5,8}	49-57	73-99	NS	0.5
Weakness ⁸	43	82	NS	NS
Speech unclear or rambling ⁸	56	82	NS	0.5

*Diagnostic standard: For *hypovolemia*, serum urea nitrogen-creatinine ratio >25, osmolality >295-300 mOsm/L, or serum sodium >145-150 mEq/L.

[†]Definition of findings: For *abnormal skin turgor*, see text.

[‡]Likelihood ratio (LR) if finding present = positive LR; LR if finding absent = negative LR.
NS, Not significant.

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These studies indicate that the presence of sunken eyes (likelihood ratio [LR] = 3.7; see [EBM Box 11.1](#)), abnormal skin turgor (tested in the subclavicular area, LR = 3.5), dry mucous membranes (LR = 3.1), and dry axilla (LR = 3) *increases* the probability of hypovolemia. Testing skin turgor over the thighs, sternum, or subclavicular area was more accurate than testing skin over the forearms.⁵ The *absence* of tongue furrows and presence of normal skin turgor *decrease* the probability of hypovolemia (LR = 0.3 for both findings). The presence or absence of confusion, weakness, or abnormal speech had little diagnostic value in these studies.

Although poor capillary refill time has been advanced as a reliable sign of hypovolemia, it lacked diagnostic value in one study.⁸

The references for this chapter can be found on www.expertconsult.com.

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REFERENCES

1. Mange K, Matsuura D, Cizman B, et al. Language guiding therapy: the case of dehydration versus volume depletion. *Ann Intern Med.* 1997;127:848–853.
2. Osler W. *The Principles and Practice of Medicine (Facsimile by Classics of Medicine Library)*. New York: D. Appleton and Co.; 1892.
3. Dorrington KL. Skin turgor: do we understand the clinical sign? *Lancet.* 1981;1:264–265.
4. Aquilar OM, Albertal M. Images in clinical medicine. Poor skin turgor. *N Engl J Med.* 1998;338(1):25.
5. Chassagne P, Druesne L, Capet C, Menard JF, Bercoff E. Clinical presentation of hypernatremia in elderly patients: a case control study. *J Am Geriatr Soc.* 2006;54:1225–1230.
6. Eaton D, Bannister P, Mulley GP, Connolly MJ. Axillary sweating in clinical assessment of dehydration in ill elderly patients. *Br Med J.* 1994;308:1271.
7. Kinoshita K, Hattori K, Ota Y, et al. The measurement of axillary moisture for the assessment of dehydration among older patients: a pilot study. *Exp Gerontol.* 2013;48:255–258.
8. Gross CR, Lindquist RD, Woolley AC, Granieri R, Allard K, Webster B. Clinical indicators of dehydration severity in elderly patients. *J Emerg Med.* 1992;10:267–274.